

Registration of 'OK Bullet' Wheat

'OK Bullet' (Reg. No. CV-999, PI 642415) is a hard red winter (HRW) wheat (*Triticum aestivum* L.) cultivar developed cooperatively by the Oklahoma Agric. Exp. Stn. (AES), USDA-ARS, and the Texas AES and released by the Oklahoma AES and the USDA-ARS in 2005. OK Bullet is recommended for grain-only and dual-purpose production systems throughout Oklahoma and the southern Great Plains, and dryland and irrigated systems in the southern High Plains. Its name was chosen to acknowledge its exceptional ability to satisfy several targets for end-use quality attributes.

OK Bullet originated from the cross, KS96WGRC39/'Jagger', performed in 1994 by Dr. David Worrall, formerly with Texas A&M University and the Texas AES at Vernon, TX. Jagger is a HRW wheat cultivar with excellent milling and baking quality developed by the Kansas AES and the USDA-ARS (Sears et al., 1997). KS96WGRC39, which was experimentally named KS93U206, is a HRW wheat germplasm with the pedigree 'TAM 107'*3/TA 2460, and was released by the USDA-ARS, the Kansas AES, and the Wheat Genetics Resources Center (Brown-Guedira et al., 1999). This germplasm provided resistance to leaf rust (*Puccinia triticina* Eriks.) (via a gene originally named *Lr41*) and to tan spot [caused by *Pyrenophora tritici-repentis* (Died.) Drechs.]. TAM 107 is a HRW wheat cultivar, whereas TA 2460 denoted an accession of *Triticum tauschii* L.

The F₂ and F₃ generations were advanced as bulk populations in the field near Chillicothe, TX. Single heads were collected in 1997, and in the following year selection was imposed in Stillwater, OK on the F_{3,4} head-rows based on late-spring freeze tolerance, spike density and size, phenotypic uniformity, and kernel size. OK Bullet traces to a single F_{3,4} head row. Seed produced from that head row did not give the visual appearance of variable kernel color, but in subsequent generations this line was found to contain a low frequency of kernels with white seed coat (3%) based on the NaOH-stain test (Ram et al., 2002). The head-row progeny was evaluated in 1999 in non-replicated observation nurseries at Stillwater and Lahoma, OK and selected on the basis of forage accumulation, fall vegetative growth habit, simulated-grazing tolerance, spring green-up, heading date, test weight, grain yield, wheat protein content, kernel hardness, and kernel size. Subsequent generations were advanced by bulk-selecting in the field, with roguing of slightly taller variants each year until 2004. Seed from the 2002 harvest were passed through a single-kernel sorter to reduce the frequency of phenotypically white kernels to 2% (Engineering Research Unit, USDA-ARS-GMPRC, Manhattan, KS). Breeder seed was produced from a bulk increase at Goodwell, OK, with supplemental irrigation, in 2004. As of the 2005–2006 crop year, OK Bullet is an F₃-derived line in the F₁₂ generation.

OK Bullet was tested experimentally as OK00514 in replicated breeder nurseries throughout Oklahoma from 2000 through 2004, in the 2003 USDA-ARS Regional Germplasm Observation Nursery (entry 141), in the Southern Regional Performance Nursery (SRPN) in 2004 (entry 19) and 2005 (entry 36), and in the 2004 Hard Winter Wheat Milling and Baking Evaluation Program conducted by the Wheat Quality Council. It was also included in the Oklahoma State University Wheat Variety Trials in 2004 and 2005.

Milling and baking quality is an exceptional feature of OK Bullet. Across 17 site-years in Oklahoma from 2001 to 2004, OK Bullet averaged 77% large-kernel fraction using the Tyler Rotap sieve shaker (W.S. Tyler Co., Mentor, OH), 32.0 mg kernel weight based on the single-kernel characterization system (SKCS), and 2.48 mm SKCS-kernel diameter. In head-to-head comparisons in two of the 4 yr, OK Bullet exceeded Jagger ($P < 0.05$) by 48% in large-kernel fraction, 21% in kernel weight,

and 14% in kernel diameter. Coupled with large kernel size is high grain volume weight for OK Bullet, which averaged 79.3 kg hL⁻¹ across 32 site-years in Oklahoma. In head-to-head comparisons with Jagger across eight site-years, grain volume weight of OK Bullet, at 78.9 kg hL⁻¹, exceeded Jagger ($P < 0.05$) at 76.4 kg hL⁻¹, a difference sufficiently large to cause a single grade change in U.S. grading standards.

From multi-location composite grain samples evaluated in two crop seasons (2003 and 2004) by the Hard Winter Wheat Quality Laboratory (USDA-ARS, Manhattan, KS), OK Bullet averaged 700 g kg⁻¹ in flour yield with a flour ash of 3.3 g kg⁻¹. The check cultivar, 'Ok102' (Carver et al., 2004), produced values of 684 g kg⁻¹ and 3.9 g kg⁻¹ for flour yield and flour ash, respectively. Wheat and flour protein (140 g kg⁻¹ moisture basis) averaged 126 g kg⁻¹ and 114 g kg⁻¹, respectively, compared with 124 g kg⁻¹ and 112 g kg⁻¹ for Ok102. Respective values for farinograph peak time and stability were 11.2 and 17.2 min for OK Bullet and 17.4 and 24.6 min for Ok102. Straight-dough baking quality of OK Bullet is considered above-average, with 624 g kg⁻¹ bake water absorption, 5.3 min bake mixing time, 870 cc loaf volume and 4.4 for crumb-grain score on a 0 (poor)-to-6 (good) scale. Corresponding values for Ok102 were 608 g kg⁻¹ bake water absorption, 6.4 min bake mixing time, 909 cc loaf volume, and 3.5 crumb-grain score. High-molecular-weight glutenin subunits which are present in OK Bullet (and also in Jagger) at the *Glu-A1*, *Glu-B1*, and *Glu-D1* loci are, respectively, 1, 17+18, and 5+10.

OK Bullet is an awned, white-chaff, tall, semidwarf wheat with early onset of first-hollow-stem (FHS) stage and moderately early heading date. In 2004 and 2005, it reached the FHS stage in central Oklahoma 2 d later than Jagger and 16 d earlier than '2174'. Arrival at FHS stage appears to be highly responsive to temperature; thus the actual FHS date may fluctuate widely among years. Heading date is intermediate to Jagger (3 d earlier) and 2174 (2 d later). OK Bullet shows rapid stand establishment with low sensitivity to high temperature (35°C ambient temperature) during germination, and it has an erect to semi-erect vegetative growth habit (more erect than 'Ok101', less erect than 'Overley').

Though it is postulated to contain the gene, *Rht-B1b*, OK Bullet exceeds most currently grown hard winter wheat cultivars in plant height, which could be associated with its extended peduncle (36 cm in greenhouse conditions). It is about 8 cm taller than Jagger and 6 cm taller than 2174, yet ratings for lodging resistance have been acceptable. Based only on environments with substantive lodging, OK Bullet had a rating of 2.0 on a scale of 1 (tolerant) to 5 (susceptible), compared with 3.5 for Jagger and 1.0 for 2174. OK Bullet is moderately tolerant to aluminum (Al) toxicity in low-pH field conditions (pH 4.0–4.5), with a rating of 2 on a 1-to-5 scale. Similar ratings were given to Ok101 and Jagger. OK Bullet shows the same banding pattern as Jagger for the SSR markers, *wmc331* and *gdm125*, and the gene marker for malate release, *ALMT1*, on chromosome 4DL. Based on its hematoxylin stain reaction, however, OK Bullet is less tolerant to Al toxicity than the highly tolerant cultivar, 'Atlas 66'.

Based on field observations at one to two locations in Oklahoma in 2004 and 2005, OK Bullet is moderately resistant to *Wheat soilborne mosaic virus* and *Wheat spindle streak mosaic virus*, but moderately susceptible to *Barley yellow dwarf virus*. Based on field observations of adult plants across Oklahoma through 2005 (nine site-years), it showed a resistant reaction to leaf rust, caused by *Puccinia triticina* Eriks, and stripe rust, caused by *P. striiformis* Westendorp. f. sp. *tritici*. However, races able to overcome both types of resistance exist in southern Texas. The USDA-ARS Cereal Disease Laboratory (St. Paul, MN) determined that *Lr39/Lr41* was absent in OK Bullet.

Based on the most recent adult-plant leaf rust ratings collected at four Oklahoma sites in 2005, OK Bullet consistently scored 1 on a 1-to-4 scale (or a reaction type of 10R), compared to the susceptible check cultivar, 'Chisholm', which had a consistent score of 4 and a reaction type of 65S. During the stripe rust epidemic in 2005, OK Bullet consistently scored 0 across six Oklahoma sites on a scale of 0 to 4; the susceptible check, OK102, averaged 3.4. About 0.2% of the plants of OK Bullet were rated as susceptible to stripe rust (score of 3 on the 0-to-4 scale) in the field in Oklahoma in 2005.

Based on inoculated disease evaluation tests in the greenhouse, OK Bullet is moderately resistant to tan spot [*Pyrenophora tritici-repentis* (Died.) Drechs.] and to septoria leaf blotch (*Septoria tritici* Roberge in Desmaz.), but susceptible to powdery mildew (*Blumeria graminis* f. sp. *tritici*). It is susceptible to biotypes C and E of the greenbug (*Schizaphis graminum* Rondani) and to Hessian fly [*Mayetiola destructor* (Say)].

Across 30 grain-only sites of the 2004 SRPN, OK Bullet ranked 21st among 50 entries, with a mean yield of 3970 kg ha⁻¹ compared with the long-term checks, TAM 107 at 3690 kg ha⁻¹ and Trego at 3940 kg ha⁻¹ (LSD = 250 kg ha⁻¹, *P* = 0.05). In the 2005 SRPN across 32 grain-only sites, OK Bullet was the fifth highest yielding entry among 48 entries, with a mean yield of 3910 kg ha⁻¹ compared with the long-term checks, TAM 107 at 3050 kg ha⁻¹ and Trego at 3280 kg ha⁻¹ (LSD = 270 kg ha⁻¹, *P* = 0.05). In the OWVT (22 site-years), grain yield of OK Bullet averaged 3310 kg ha⁻¹, compared with 2730 kg ha⁻¹ for 2174 and 3250 kg ha⁻¹ for Jagger (LSD = 150 kg ha⁻¹, *P* = 0.05).

Flag leaves of OK Bullet at the boot stage are green, recurved, twisted, and non-waxy. Spikes are white-chaffed, awned, oblong, middense, and inclined at harvest-maturity. Kernels are red, hard-textured, ovate, and they have a midwide, middeep crease, rounded cheeks, and large germ.

Small quantities of seed of OK Bullet may be obtained from the corresponding author for at least 5 yr for research purposes, including use in development and commercialization of new cultivars. Seed has been deposited in the National Plant Germplasm System. Appropriate recognition is requested if this release contributes to the development of a new breeding line or cultivar. Authorized seed classes are Breeder, Foundation, Registered, and Certified. Foundation seed may be obtained through Foundation Seed Stocks, Dep. of Plant and Soil Sciences,

Oklahoma State Univ., Stillwater, OK 74078. The Oklahoma Agricultural Experiment Station will maintain Breeder seed. Application for U.S. Plant Variety Protection (Title V) is pending.

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